



State Government R&D Expenditures Increased 3% in FY 2018; Energy-Related R&D Up 29%

by Christopher Pece¹

State government agency expenditures for research and development totaled \$2.5 billion in FY 2018, an increase of 3% from FY 2017 (table 1). Health-related R&D expenditures were \$1.1 billion, continuing to constitute the largest share (44%) of all state government agencies' R&D. Energy-related R&D expenditures increased 29% between FY 2017 and FY 2018, reaching \$397 million. This InfoBrief presents summary statistics from the FY 2018 Survey of State Government Research and Development, sponsored by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation. Amounts reported do not include direct appropriations from state legislatures to universities, colleges, and private organizations.

National Totals

Of the \$2.5 billion in state government agency R&D expenditures in FY 2018, 79% came from state and other nonfederal sources (table 1). The majority (75%) of state government agency R&D expenditures went to extramural R&D performers (i.e., performers other than state agencies). Higher education institutions were the primary recipi-

TABLE 1. State agency R&D and R&D facilities expenditures: FYs 2017–18
(Thousands of current dollars)

Characteristic	FY 2017	FY 2018	% change
All R&D and R&D plant expenditures	2,542,700	2,556,103	0.5
All R&D plant expenditures	68,023	12,766	-81.2
All R&D expenditures	2,474,677	2,543,337	2.8
Source of funds			
Federal government	537,298	525,655	-2.2
State government and other nonfederal sources	1,937,379	2,017,682	4.1
Performer			
Intramural ^a	640,188	640,830	0.1
Extramural	1,834,489	1,902,507	3.7
Higher education institutions	1,062,361	1,078,949	1.6
Companies and individuals	437,744	446,530	2.0
Other	334,384	377,028	12.8
Intramural by type of R&D			
Basic research	97,529	110,465	13.3
Applied research	521,085	507,775	-2.6
Experimental development	21,574	22,590	4.7
R&D project by government function			
Agriculture	117,483	129,950	10.6
Energy	307,574	397,037	29.1
Environment and natural resources	451,189	423,882	-6.1
Health	1,109,237	1,109,667	0.0
Transportation	265,470	258,419	-2.7
Other ^b	223,723	224,383	0.3

^a Intramural performers include employees within the same state department or agency and services performed by others in support of internal R&D projects.

^b Includes government functions for corrections, criminal justice, education, forensic sciences, labor, public safety, and social services.

NOTES: R&D plant includes acquisition of land, facilities, major equipment, and major building renovations intended primarily for R&D use. Detail may not add to total because of rounding.

SOURCE: National Center for Science and Engineering Statistics, National Science Foundation, Survey of State Government Research and Development.

ents of these expenditures with 57% of all extramural funding,² followed by companies and individuals (23%). Intramural performers of R&D, the state agencies themselves, received \$640.8 million in FY 2018, up slightly from the \$640.2 million in FY 2017.

Although all state governments had expenditures for R&D in FY 2018, the amounts are often concentrated in a handful of states. For instance, six state governments (California, New York, Texas, Florida, Pennsylvania, and Ohio)

accounted for 67% of all state government R&D expenditures in FY 2018 (table 2).

Expenditures for R&D plant (construction projects, major building renovations, major equipment purchases, and land and building acquisitions intended primarily for R&D use) totaled \$12.8 million in FY 2018, an 81% decrease from the \$68.0 million reported in FY 2017 (table 1). R&D plant expenditures are highly variable year to year and will increase or decrease as projects begin or end.

State Governments' R&D Funding and Performance

Overview

Individual state government expenditures on R&D in FY 2018 ranged considerably, from \$1.8 million in Vermont to \$633.1 million in California, but these expenditures also vary by state between extramural and intramural R&D (table 2). Overall, 75% of states' \$2.5 billion R&D expenditures are provided to extramural performers; 25% of the total was for state intramural R&D performance.

TABLE 2. Total and federal funding for state agency expenditures for R&D, by state and performer: FY 2018
(Thousands of current dollars)

State	Intramural performers ^a		Extramural performers ^b		State	Intramural performers ^a		Extramural performers ^b			
	All R&D expenditures	Total	Federal funds	Total		Federal funds	All R&D expenditures	Total	Federal funds	Total	Federal funds
United States ^c	2,543,337	640,830	254,146	1,902,507	271,509	Missouri	16,341	8,694	596	7,648	3,519
Alabama	21,653	11,466	4,177	10,187	4,346	Montana	8,867	2,684	1,824	6,183	2,542
Alaska	10,812	7,376	1,257	3,436	1,019	Nebraska	26,564	580	303	25,985	1,378
Arizona	12,937	1,618	1,454	11,319	2,875	Nevada	7,283	141	113	7,143	1,034
Arkansas	16,325	203	77	16,122	6,219	New Hampshire	8,269	151	86	8,118	608
California	633,061	78,250	6,899	554,811	26,116	New Jersey	51,295	1,692	70	49,603	5,703
Colorado	30,640	9,120	3,144	21,521	1,753	New Mexico	3,360	1,241	735	2,120	1,467
Connecticut	54,492	22,503	9,639	31,990	4,161	New York	450,161	240,592	117,308	209,569	33,499
Delaware	3,857	2,533	734	1,324	1,009	North Carolina	33,719	19,372	1,861	14,347	7,224
District of Columbia	4,633	2,022	861	2,611	1,498	North Dakota	16,108	1,828	1,163	14,281	1,802
Florida	186,499	51,598	13,704	134,901	13,274	Ohio	99,811	7,869	166	91,942	9,783
Georgia	18,121	2,346	0	15,775	7,486	Oklahoma	27,841	1,728	936	26,113	7,248
Hawaii	12,982	213	1	12,769	6,649	Oregon	37,690	20,005	12,104	17,685	4,282
Idaho	15,691	6,173	5,120	9,518	2,791	Pennsylvania	101,611	7,237	4,853	94,373	1,949
Illinois	17,502	1,171	0	16,331	5,330	Rhode Island	3,365	1,639	842	1,726	11
Indiana	19,814	243	195	19,571	5,805	South Carolina	34,292	28,354	20,217	5,937	3,926
Iowa	9,710	2,897	1,956	6,813	3,868	South Dakota	4,137	330	223	3,807	927
Kansas	12,840	2,089	1,411	10,751	4,357	Tennessee	9,232	2,322	1,592	6,910	3,794
Kentucky	22,453	2,135	1,339	20,318	6,137	Texas	228,578	3,201	2,118	225,377	18,648
Louisiana	37,057	13,442	9,193	23,615	12,700	Utah	27,593	18,237	164	9,356	1,191
Maine	15,991	2,802	2,077	13,189	980	Vermont	1,842	561	482	1,281	1,165
Maryland	30,960	2,744	2,248	28,215	1,973	Virginia	30,596	12,932	3,788	17,664	5,846
Massachusetts	23,001	8,363	4,552	14,638	2,286	Washington	37,093	15,395	6,366	21,698	5,583
Michigan	7,690	0	0	7,690	5,775	West Virginia	10,493	2,642	1,118	7,851	5,563
Minnesota	18,502	673	572	17,830	3,871	Wisconsin	15,880	5,271	2,073	10,609	4,898
Mississippi	9,205	1,791	1,294	7,414	4,402	Wyoming	4,886	2,362	1,141	2,524	1,239

^a Intramural performers include employees within the same state department or agency and services performed by others in support of internal R&D projects.

^b Extramural performers include academic institutions, companies and individuals, and other non-internal performers.

^c U.S. total reflects all 50 states and the District of Columbia.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Center for Science and Engineering Statistics, National Science Foundation, Survey of State Government Research and Development, FY 2018.

Intramural R&D Performance

Five states accounted for 66% of the \$640.8 million in expenditures for intramural R&D performed by all state agencies in FY 2018: New York (\$240.6 million), California (\$78.3 million), Florida (\$51.6 million), South Carolina (\$28.4 million), and Connecticut (\$22.5 million) (table 2). In FY 2018, 40% (\$254.1 million) of all state agency intramural R&D performance was supported by federal funds. However, federal funding for state intramural R&D is highly concentrated, with four states accounting for 64% of all federal funding used for intramural R&D. New York State, alone, received 46% (\$117.3 million) of all federal funding used by state agencies for intramural R&D, while South Carolina received 8% (\$20.2 million), Florida received 5% (\$13.7 million), and Oregon received 5% (\$12.1 million) (table 2).

The majority (79%) of state government intramural R&D performance in FY 2018 is directed toward applied research (\$507.8 million), whereas basic research constitutes approximately 17% (\$110.5 million) and experimental development is 4% (\$22.6 million) (table 1). All state governments, except Michigan³ and Nebraska, reported a portion of their intramural R&D as applied research.⁴ In FY 2018, 28 state governments reported some intramural R&D as basic research and 25 reported some intramural R&D as experimental development. Fourteen state governments reported all their intramural R&D as applied research. New York accounts for 61% of all intramural state government expenditures for basic research, 34% of all applied research, and 14% of all experimental development.

Extramural R&D Performance

Six states accounted for 69% of the total \$1.9 billion in FY 2018 state government expenditures for extramural R&D performance: California (\$554.8 million), Texas (\$225.4 million),

New York (\$209.6 million), Florida (\$134.9 million), Pennsylvania (\$94.4 million), and Ohio (\$91.9 million) (table 3). However, states varied in how they distributed extramural R&D. For example, Texas state agencies directed 81% of their extramural funding for R&D toward higher education institutions (\$181.6 million) compared with 19% (\$42.6 million) to companies and individuals. By comparison, Ohio state agencies directed 69% of their funding for extramural R&D performance toward companies and individuals (\$63.4 million) and 29% (\$27.0 million) to higher education. California's distribution of extramural R&D funding is relatively balanced across the three sectors with 37% (\$205.6 million) directed towards higher education, 35% (\$194.9 million) directed towards companies and individuals, and 28%, (\$154.3 million) towards other performers.

In addition to Texas, state agencies in California (\$205.6 million), New York (\$120.2 million), Florida (\$81.8 million), Pennsylvania (\$53.9 million), and Ohio (\$27.0 million) combined accounted for 62% of the total support to higher education institutions (\$1.1 billion) in FY 2018. Similarly, state agencies in California (\$194.9 million), Ohio (\$63.4 million), Texas (\$42.6 million), New York (\$23.3 million), and Connecticut (\$20.7 million) combined accounted for 77% of the total R&D support from state governments to companies and individuals (\$446.5 million) in FY 2018.

The share of federal funds was much smaller for extramural R&D expenditures than for intramural R&D expenditures (14% versus 40%) (table 2). However, similar to intramural expenditures, federal funds for extramural R&D are concentrated in some

TABLE 3. State agency expenditures for R&D, by state and performer, for the 10 states with the highest level of all R&D expenditures: FY 2018
(Thousands of current dollars)

State	All R&D expenditures ^a	Intramural performers ^b	Extramural performers ^c			
			Total	Higher education institutions	Companies and individuals ^d	Other ^e
United States ^f	2,543,337	640,830	1,902,507	1,078,949	446,530	377,028
California	633,061	78,250	554,811	205,577	194,896	154,337
New York	450,161	240,592	209,569	120,150	23,336	66,084
Texas	228,578	3,201	225,377	181,620	42,580	1,177
Florida	186,499	51,598	134,901	81,819	5,436	47,646
Pennsylvania	101,611	7,237	94,373	53,913	2,404	38,055
Ohio	99,811	7,869	91,942	27,003	63,404	1,535
Connecticut	54,492	22,503	31,990	10,071	20,665	1,254
New Jersey	51,295	1,692	49,603	47,544	318	1,742
Oregon	37,690	20,005	17,685	6,643	9,756	1,285
Washington	37,093	15,395	21,698	14,205	5,106	2,387
All others	663,046	192,488	470,558	330,404	78,628	61,525

^a State R&D expenditures do not include R&D plant.

^b Intramural performers include employees within the same state department or agency and services performed by others in support of internal R&D projects.

^c Extramural performers are those outside the department or agency who perform R&D.

^d Companies and individuals include individuals under contract for research projects.

^e Other includes federal government; nonprofit organizations; city, county, regional, or other local governments; and other state governments.

^f U.S. total reflects all 50 states and the District of Columbia.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Center for Science and Engineering Statistics, National Science Foundation, Survey of State Government Research and Development, FY 2018.

of the larger state governments. New York, California, Texas, Florida, and Louisiana accounted for 38% (\$104.2 million) of all federal funds used for extramural R&D.

R&D by State Government Functions

Most states reported a broad mix of R&D projects related to state government functions: agriculture, energy, environment and natural resources, health, and transportation (table 4). Health-related R&D expenditures account for the largest share (44%) of state agencies' R&D. Environment and natural resources R&D expenditures accounted for 17% of total state government R&D expenditures in FY 2018. Energy-related R&D expenditures increased 29% from FY 2017 and now constitute 16% of all state government R&D. Transportation, agriculture, and all other projects' shares of total R&D expenditures in FY 2018 were 10%, 5%, and 9%, respectively.

Among all functions, health-related R&D have shown the most growth between FY 2009 and FY 2018 (figure 1). When adjusted for inflation,⁵ health R&D expenditures increased 46% from \$686.8 million in FY 2009 to \$1.0 billion in FY 2018. During the same 9-year period, agriculture and environment and natural resources-related R&D expenditures increased 69% and 12%, respectively, while transportation decreased 8% from \$254.0 million in FY 2009 to \$234.3 million in FY 2018. The energy function was not collected separately until FY 2010,⁶ but it has shown increases in inflation-adjusted expenditures of 52% from FY 2010 to FY 2018.

Agency R&D Details

Of all 706 state agencies that responded to the survey in FY 2018, the largest 20, by total expenditures, accounted for 62% of all agency R&D expenditures (table 5). These agencies accounted for \$933.8 million of the \$1.1 billion in state agency health R&D, or 84%, while also accounting for 86% of all state

government energy R&D. The largest individual state agency, the California Institute for Regenerative Medicine constituted 22% of all health-related R&D. Similarly, the California Energy Commission accounted for 53% of all state agencies' energy-related R&D expenditures. Although health and energy functions are highly concentrated in handful of agencies, the largest 20 agencies only account for 15% and 16% of all agriculture- and transportation-related R&D, respectively.

Data Sources and Limitations

Data presented in this InfoBrief are in current dollars, unless specifically cited that they have been adjusted for inflation. All 50 states and the District of Columbia participated in the FY 2018 survey, and 706 of the 759 selected agencies (93%) responded to the survey. Puerto Rico agencies did not respond to the survey for FY 2018. Data for the FY 2018 survey were collected for NCSSES by the U.S. Census Bureau under an interagency agreement.

Most states' fiscal years begin on 1 July and end the following 30 June. For example, FY 2018 begins on 1 July 2017 and ends on 30 June 2018. There are, however, five exceptions to the 30 June fiscal year end: New York (ends 31 March), Texas (ends 31 August), and Alabama, Michigan, and the District of Columbia (ends 30 September). Data presented in this InfoBrief are for each of the respective fiscal year periods as defined by the states.

Terms such as state, state government, and state agencies have equivalent meaning and are used interchangeably throughout this InfoBrief. The amounts reported here are for R&D expenditures of state government departments, agencies, public authorities, institutions, and other dependent entities that operate separately or somewhat autonomously.

TABLE 4. State agency expenditures for R&D, by state and function of R&D, for the 10 states with the highest levels of R&D expenditures: FY 2018 (Thousands of current dollars)

State	Total	Agriculture	Energy	Environment and natural resources	Health	Transportation	Other
United States ^a	2,543,337	129,950	397,037	423,882	1,109,667	258,419	224,383
California	633,061	5,835	243,987	41,221	287,552	36,226	18,240
New York	450,161	10,579	86,542	23,271	267,112	14,441	48,217
Texas	228,578	1,054	0	9,895	200,382	17,248	0
Florida	186,499	20,044	585	50,930	98,470	16,471	0
Pennsylvania	101,611	1,687	0	8,326	52,933	1,714	36,950
Ohio	99,811	0	15,071	54,610	4,017	7,079	19,034
Connecticut	54,492	3,322	0	10,218	29,361	3,150	8,442
New Jersey	51,295	0	0	1,823	43,408	6,064	0
Oregon	37,690	741	2,250	14,528	10,836	3,445	5,890
Washington	37,093	11,663	3,309	12,727	1,189	4,852	3,354
All others	625,988	74,988	44,536	183,881	113,176	138,229	71,178

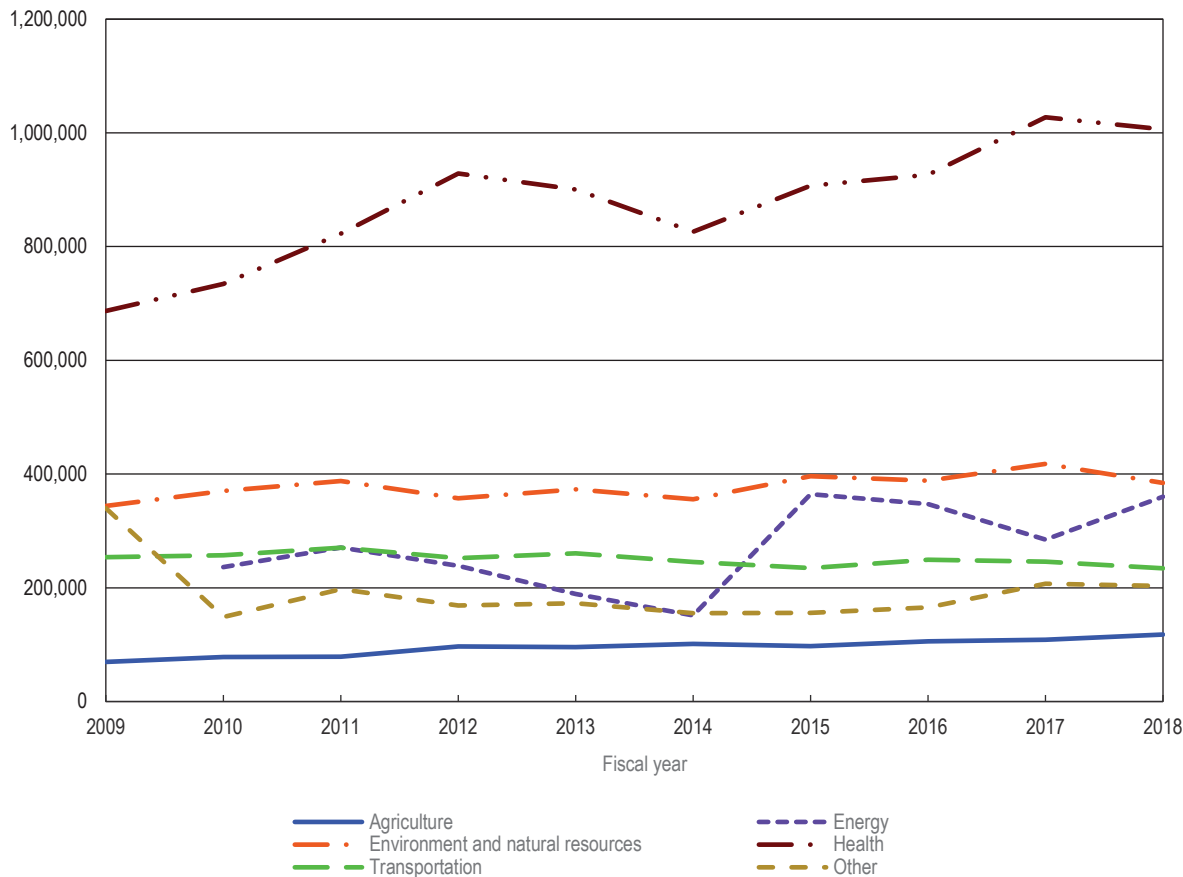
^a U.S. total reflects all 50 states and the District of Columbia.

NOTES: Includes state agency funding from all sources for both intramural and extramural performance. Detail may not add to total because of rounding.

SOURCE: National Center for Science and Engineering Statistics, National Science Foundation, Survey of State Government Research and Development, FY 2018.

FIGURE 1. All state government expenditures for R&D, by function: FYs 2009–18

Thousands of constant 2012 dollars



NOTES: Gross domestic product implicit price deflators were used to convert current to constant dollars. Because of rounding, detail may not add to total. State R&D totals can display considerable volatility between survey years due to several national and state-specific factors. Large changes are not unusual, especially for discretionary spending items such as R&D. The Energy category was introduced with the FY 2010 and FY 2011 Survey of State Government Research and Development. Previously, energy-related R&D was reported primarily in the categories Other and Environment and natural resources.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of State Government Research and Development.

mously from the central state government. State government R&D totals can display considerable volatility between survey years due to several national and state-specific factors. Large changes are not unusual, especially for discretionary spending items such as R&D.

Amounts reported do not include direct appropriations from state legislatures to universities, colleges, and private organizations. As a result, the \$1.0 billion in FY 2018 expenditures reported by state agencies to support R&D perfor-

mance by academic institutions differs from the figure reported by universities and colleges in FY 2018 (\$4.3 billion) for expenditures on R&D activities that were funded from state and local government sources. (See National Center for Science and Engineering Statistics, National Science Foundation. 2018. *Higher Education Research and Development: Fiscal Year, 2018*. Data Tables. Alexandria, VA. Available at <https://www.nsf.gov/statistics/srvyherd/#tabs-2>.)

State- and agency-specific data not available in this InfoBrief will be available in the full set of data tables from this survey in the report *State Government Research and Development: FY 2018*, at <https://www.nsf.gov/statistics/srvystaterd/#tabs-2>. Individual data tables from the FY 2018 survey may be available in advance of the full report. For further information, contact the author.

TABLE 5. Individual state agency expenditures for R&D, by total R&D and function, for the 20 largest agencies: FY 2018
(Thousands of current dollars)

State	Total	Agriculture	Energy	Environment and natural resources	Health	Transportation	Other
United States ^a	2,543,337	129,950	397,037	423,882	1,109,667	258,419	224,383
Institute for Regenerative Medicine (California)	248,755	0	0	0	248,755	0	0
Energy Commission (California)	211,740	0	211,740	0	0	0	0
Cancer Prevention and Research Institute (Texas)	195,632	0	0	0	195,632	0	0
Mental Health, Office of (New York)	144,129	0	0	0	144,129	0	0
Health, Department of (Florida)	97,232	0	0	0	97,232	0	0
Energy Research and Development Authority (New York)	88,260	0	80,252	3,498	0	4,509	0
Development Services Agency (Ohio)	85,026	0	14,927	52,596	2,267	981	14,254
Health, Department of (New York)	64,181	277	0	1,662	62,242	0	0
Roswell Park Cancer Institute (New York)	58,694	0	0	0	58,694	0	0
Fish and Wildlife Conservation Commission (Florida)	50,642	0	0	50,642	0	0	0
Economic Development, Department of (New York)	47,987	0	0	0	0	0	47,987
Health, Department of (Pennsylvania)	47,514	0	0	0	47,514	0	0
Community and Economic Development, Department of (Pennsylvania)	41,950	0	0	0	5,000	0	36,950
Transportation, Department of (California)	36,226	0	0	0	0	36,226	0
Health, Department of (New Jersey)	33,978	0	0	0	33,978	0	0
Public Utilities Commission, Executive Division (California)	32,547	0	32,247	0	0	0	300
Innovation Inc. (Connecticut)	27,043	0	0	0	18,651	0	8,392
Natural Resources, Department of (South Carolina)	26,858	0	0	26,858	0	0	0
Agriculture and Consumer Services, Department of (Florida)	21,140	19,394	585	288	874	0	0
Health and Human Services (Nebraska)	18,786	0	0	0	18,786	0	0
All other agencies	965,019	110,279	57,284	288,338	175,914	216,702	116,500

^a U.S. total reflects all 50 states and the District of Columbia.

NOTES: Includes state agency funding from all sources for both intramural and extramural performance. Detail may not add to total because of rounding.

SOURCE: National Center for Science and Engineering Statistics, National Science Foundation, Survey of State Government Research and Development, FY 2018.

Notes

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2. State agency expenditures directed toward higher education institutions under this survey do not include direct state appropriations to colleges and universities.

3. See table 2. Michigan is the only state government that did not report having any intramural R&D in FY 2018.

4. Data for state government expenditures for intramural R&D, by state and type of R&D (i.e., basic research, applied research, and experimental development) are available in the detailed statistical table 7, available at <https://www.nsf.gov/statistics/srvystaterd/#tabs-2>.

5. Gross domestic product implicit price deflators were used to convert current to constant 2012 dollars. Data on federal fiscal year, historical figures, 1953–2018 can be found in Office of Management and Budget. 2019. Budget of the U.S. Government, Fiscal Year 2020. Historical Tables (Table 10.1). Available at <https://www.govinfo.gov/features/budget-fy2020>. Data on

projections, 2019–21 can be found in Office of Management and Budget. 2019. Economic assumptions and overview. In *Analytical Perspectives, Budget of the U.S. Government, Fiscal Year 2020*. Available at <https://www.whitehouse.gov/wp-content/uploads/2019/03/spec-fy2020.pdf>.

6. The Energy category was introduced with the FY 2010 and FY 2011 Survey of State Government Research and Development. Previously, energy-related R&D was reported primarily in the other category, and to some degree in the environment and natural resources category.